Economic impacts of high speed trains: experiences in Japan and France, expectations in The Netherlands

Bruinsma, F.R.; Rietveld, P.; van Delft, H.T.; Ubbels, B.J.

2001

document version
Early version, also known as pre-print

Faculteit der Economische Wetenschappen en Bedrijfskunde

SERIE RESEARCH MEMORANDA

Economic impacts of high speed trains

Experiences in Japan and France: expectations in The Netherlands

P. Rietveld
F.R. Bruinsma
H.T. van Delft
B. Ubbels

Research Memorandum 2001-20

June 2001

vrije Universiteit amsterdam

Economic impacts of high speed trains

Experiences in Japan and France: expectations in The Netherlands

Prof. Dr. P. Rietveld
Dr. F. R. Bruinsma
Drs. H.T. van Delft
Drs. B. Ubbels

Department of Spatial Economics
Vrije Universiteit Amsterdam
De Boelelaan 1105
108 1 HV Amsterdam
The Netherlands

1. Introduction

Japan was the first country in the world to construct a high speed train (HST)-network in 1964. By now, also Europe has started to construct infrastructure for high-speed trains, although on a smaller scale. However, it is expected that the European high speed train network will be one of the most important infrastructure projects which will determine the transport pattems within the European Union in the coming decades. In 1981, the first TGV in France rode between Paris and Lyon. In Europe, since then a HST-network began to develop which is continually branching. By now, high speed trains are riding in, among others, Spain, Italy, England, Belgium and Germany. In 1994, the Dutch govemment decided that The Netherlands - in particular the densely urbanised Randstad area in the West of the country - should be linked to the HST-network; they agreed to construct a new high speed train links (HSL) from the Belgium border to Amsterdam (HSL-South). Moreover, the intention is to construct a connection from Amsterdam to the German *hinterland* (HSL-East). These new lines should guarantee a good connection to the European HST-network.
However, these are not the only developments conceming construction of high speed rail connections in The Netherlands. More and more, a high speed rail connection from The Randstad to The North of The Netherlands is considered (see figure 1). This connection - the so-called Zuiderzeelink (ZZL) - links Amsterdam-Schiphol Airport via Flevoland to The North of The Netherlands. This connection is considered to play a relevant role in strengthening the spatial and economic structure of The North and will be either a high speed train link or a Magnetically Levitated train (Maglev) link.
It may be clear that the construction of such a connection will have different spatial impacts on the national and regional economies considered, also depending on the design (Maglev, HSL or conventional track).
In order to come to a well-considered decision about the construction of a high speed link, it is important to make an overview of the different costs and benefits of constructing such a link. Experiences elsewhere could help in providing such an overview. Various countries have experiences with a HST for example France (TGV), Germany (ICE), Japan (Shinkansen) and Spain (AVE). This paper discusses experiences from the past, in particular in Japan and France. These experiences will be compared to the expectations on the impacts of the introduction of the above mentioned high speed links in The Netherlands. This paper starts with a genera1 review of the economic effects of infrastructure (section 2). Next, the observed spatial economic effects in France and Japan are presented in section 3. Then, the results of the cost-benefit analyses of the Dutch high speed rail links are discussed (section 4). In addition, the expected spatial economic effects of constructing a HSL for The Netherlands are addressed (section 5). Section 6 concludes.

2. Economic effects of transport infrastructure

2.1 Economic effects in genera1

Transport infrastructure is dependent on economic development and vice versa. This becomes evident from the various definitions and characteristics of infrastructure from the literature (see Nijkamp et al., 2000). The support of production and consumption processes is a basic characteristic of infrastructure. Facilities like roads and railways can be considered as a necessary condition for the functioning of the economy.

Figure 1: The planned high speed rail links of The Netherlands

In table 1, the effects for the economy are categorised on the base of time horizon (temporary or permanent) and directness (indirect or direct).

Table 1 Economic effects of constructing infrastructure

	Direct	**Indirect**
Temporary	Employment in construction firms	Employment in supplying firms
Permanent	Transport costs of users	Changes in economic structure: relocation of economic activity

First, the construction of infrastructure, a new high speed rail link for instance, provides income and employment in sectors which are directly involved in the construction. Furthermore, these sectors generate production and employment via intermediate and consumptive demand in other sectors of the economy (indirect effects). However, these effects are temporary and will not occur after realisation of the project.
Secondly, an infrastructure project has a permanent effect. New infrastructure causes lower transport costs (especially by reduction in travel times) resulting in cost saving and a larger market for firms and households. This results in relocation of activities of households and firms (indirect permanent effects). The size of such effects depends on the characteristics of the considered infrastructure projects and the context (strength of the national and regional economy, regional specific characteristics, quality and density of the existing network, etc.) in which the new transport connection is constructed.
In this paper we deal with the relocation pattems of households and firms (spatial economic impacts). Before discussing those impacts in depth, we give a brief overview of how they are dealt with in evaluation studies in various countries.

2.2 Evaluation of economic impacts of transport infrastructure projects

In a special issue of Transport Policy (Volume 7 (1), 2000) the economic evaluation of transport infrastructure in different countries (UK, Germany, France, EU, Japan, USA) is discussed. The most common forms of appraisal in use in the EU-member states are cost-benefit analysis and multi-criteria analysis (Bristow and Nellthorp, 2000). In many countries the CBA is supplemented by a quantitative and/or qualitative appraisal to include other impacts which are not monetised for technical or politica1 reasons. In general, a cost-benefit table covers three categories of impacts:

1. Direct impacts;
2. Environmental impacts;
3. Socio-economie impacts.

Direct impacts are usually incorporated in a CBA, with all countries placing a money value on construction costs, vehicle operating costs, time savings and safety. There is a significant degree of agreement on the direct impacts to be included and the appropriateness of monetary valuation.
The range of *environmental impacts* included in appraisal varies considerably across countries. However, noise and local air pollution are always included. Nevertheless, there is hardly agreement on the monetary valuation of environmental impacts.
The coverage of *socio-economie impacts* is the area where there is least agreement on the impacts to be included, with some countries excluding such impacts and others including a wide range. These effects are indirect, difficult to predict or measure and there is often some dispute as to whether they are genuinely additional to the direct project costs and benefits (Bristow and Nellthorp, 2000).
In the remainder of this discussion on evaluation methods we will emphasise the different approaches used to assess the indirect spatial economic impacts.

In the UK, the cost benefit analysis is used both to evaluate and rank projects and the results are an important element in the decision procedure (Vickerman, 2000). Regional or local economic impacts are specifically excluded from the analysis because of the concern of double counting of such effects in the direct transport benefits. The New Approach to Appraisal (NATA), a strategic review of road building policy, aims to deal with some of these elements, but detailed definition has been postponed.

The evaluation method of the Federal Traffic Infrastructure in Germany is based on a cost-benefit analysis for investment projects in the transport sector, and is specifically designed to allow a comparative assessment of projects (Rothengatter, 2000). Regional impact analysis comprises four criteria: employment effects during the construction period, employment effects related to the operation of new infrastructure, benefits from improved spatial situation and improvements of intemational exchange. Here, the spatial impact criteria lead to a double counting of other benefit measures like cost and time savings because the latter are considered a second time for less developed regions.

In France, effects on employment and local development are not taken into account in the cost-benefit analysis (Quintet, 2000). Many effects on local development are just relocation effects: what is gained by one region is lost by the other one; in that case, at a national level, they cancel out. Second, one could advocate a productivity effect of public investments higher than usual collective-surplus based on endogenous growth mechanisms. But the results of these works are rather uncertain and do not allow for differentiation between projects. Effects on employment and local development are also uncertain, so these are assessed apart from the main cost-benefit analysis.

Table 2: Method per socio-economie impact by country (1997)

	Land Use	Economic Development	Employ-ment	Economie and social cohesion	Intern ational traffic	Interoper -ability	Regional Policy	Conformity to Sector Plans	Peripher ality/ Distribut -ion
Aus	MCA +QA	MCA+QA							
Bel		MCA+MI	MCA+ MI				MCA+MI	MCA+MI	
Den									
Fin	MI	MI	MI						
Fra		QA	QA		QA				QA
Ger		CBA	CBA		CBA		CBA		
Gre	MCA +MI	MCA+CBA	MCA+ MI	MCA+MI	MCA+ MI	MCA+MI	MCA+MI	QA	MCA+ MI
Irl		MI	MI					QA	
Ita	QA	QA	MI		MI				
Nrl	MCA +QA	MCA+QA					MCA+ QA		
Por		MI	QA	QA					
Spa			CBA	CBA				QA	
Swe									
UK	QA						QA		

CBA = cost-benefit analysis MCA = Multi-criteria analysis MI = measured impacts QA = Qualitative assessment

Source: Bristow and Nellthorp, 2000

Bristow and Nellthorp (2000) give an overview of how the socio-economie impacts are dealt with in the project appraisal in the EU member states (see table 2). They state that output and employment are perhaps the best examples of impacts held to be of substantial policy relevance in most countries, but where there is little agreement and much controversy over appraisal methods. The German method allows for employment to be forecast and evaluated in money terms. The values per job are based on the altemative cost of providing a job. In the UK until 1998, and in Denmark and Sweden output and employment effects were omitted altogether. In the UK a lively debate has reopened over how such effects can reliably be predicted. More technically, ambitious methods which in principal offer more robust forecasting based on land use and transport interaction modelling are stil1 at the research and development phase (Bristow and Nellthorp, 2000).

In Japan, the present appraisal method employs a kind of multi-criteria analysis supplemented by cost-benefit analysis and by quantitative and/or qualitative evaluation. It covers many aspects including regional economic impacts (Morisugi, 2000).
The cost-benefit analysis has come to dominate other methods of evaluation in the US (Lee, 2000). All impacts can be classified into costs, benefits and transfers. The majority of impacts are considered to be transfers in which individuals may gain or lose but society as a whole is not affected. Lee (2000) argues that a federal grant that goes to one region is likely to be a benefit to the receiving region, but the relevant comparison is between the benefits of the project in one region versus another. Multiplier effects amount to double and triple counting but still economic benefits from publicly supported projects (stadiums, convention centres, etc.) are claimed to occur to the region. Therefore, the results from regional economic impact analysis should be identified as transfers and treated as an equity issue.

From this short description of economic evaluation methods of transport infrastructure projects in different countries we may conclude the following. In order to avoid double counting, regional economic impacts are not explicitly taken into account in almost all countries (Hayashi and Morisugi, 2000). There are deep-rooted theoretical and practica1 problems with using many of the traditional regional economic impact methodologies to assess transport infrastructure investment, so that it is difficult to forecast with meaningful levels of accuracy what the output and employment effects of transport investment will be. Also, there is little agreement about what monetary value, if any should be accorded to employment which is created or safeguarded by the project (Bristow and Nellthorp, 2000). Changes in transport provision may lead to specific local growth, but much of this will be a redistribution of economic activity between regions or localities rather than net overall growth. This is one of the aspects we will deal with in the next section where we discuss the spatial economic impacts in depth.

2.3 Spatial economic effects of infrastructure reconsidered

Henceforth, we will focus on the indirect (permanent) effects of infrastructure, particularly on the effects of the construction of high speed train tracks. The spatial economic impacts of the construction of the high speed rail network may occur at the national and the regional level. At the national leve1 an improvement of the intemational accessibility due to the connection to an intemational high speed rail network may lead to the location of intemational firms that would not locate there without this connection. The location of such intemational firms implies the generation of new jobs for the national economy. In case of cost-benefit analysis such intemational relocations are clearly a benefit for the national economy as a whole.
At the regional level, a redistribution of firms and households will occur of which it is uncertain whether the net contribution to the national economy is positive or negative. This aspect will be discussed in detail here. The high speed rail network may result in two effects for travellers compared to the situation without the high speed rail network. Those who continue to use the train experience a decrease in travel time (assuming that charges remain unaltered, their welfare gains are equal to the monetary value of travel time gains). Those who change their travel behaviour (shift transport

mode, or relocate and use the train) have welfare gains that are smaller than the above-mentioned monetary value of travel time gain.

In the long term, those effects might lead to the relocation of companies and households in the direction of access points in the high speed rail network. Nodes in the high speed rail network become relatively more attractive compared to points that are not connected due to their increased accessibility. This leads to four different situations on the regional labour market depending on the accessibility (connected to the high speed rail network or not) and the supply or demand shortages on the labour market. In table 3, these four situations are highlighted (see also figure 2, upper side relations).

Table 3: Impacts of HSL construction on the relocation of firms on the regional labour markets for four different types of regions

	Excess supply of labour (unemployment) (A,C)	**Excess demand of labour (vacancies) (B, D)**
Connected to the HST-network (A, B)	Relocation towards **A** (from B, C & D) Increasing demand for labour in a region with high unemployment National benefit	Relocation towards **B** (from A, C & D) Increasing demand for labour in a region suffering by labour shortages National cost
Not connected to the HST-network (C, D)	Relocation out of C Decreasing demand for labour in a region with high unemployment National cost	Relocation out of **D** Decreasing demand for labour in a region with labour shortages National benefit

Note: see figure 2 for network representation

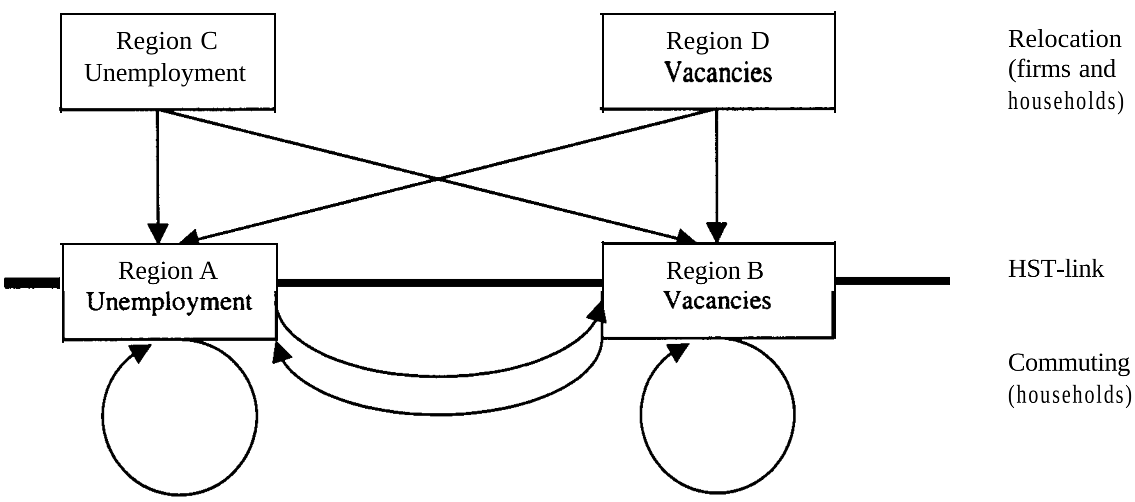

Figure 2: Relocation (firms and households) and commuting (households) patterns between connected and unconnected regions

In regions that are linked to the high speed rail network (A and B) the demand for labour increases and opposite in regions that are not linked the demand for labour will decrease[1]. Increased demand in a region with high pressure on the labour demand (many vacancies) will increase the market imperfections, whereas increased demand

[1] In this test we use the term 'relocation' to denote a combination of three processes: relocation of firms, formation of new firms and growth of existing firms. In the discussion we focus on first order effects.

in a region with high unemployment rate will decrease market imperfections. The opposite holds for regions not connected to the high speed rail network that have to deal with a decreasing demand for labour (C and D). In region D the labour market will become more balanced, whereas in region C the unemployment situation will be aggravated. Note that the balance of the relocation of firms between regions A and B is not certain. Both regions become more accessible and this implies that a process of increasing specialisation may be expected, some sectors growing fast in region A and other sectors growing fast in region B. Given the excess supply of labour in region A one may expect labour intensive firms in this region to be positively affected by HSL construction. We note in passing that the experience with the French TGV is that the net shifts in aggregate employment between cities connected to the HSL network are modest.

Above we described the labour demand relations (relocation of firms). In the same way we could describe the relocation of households (the supply side of the labour market). Obviously, the impact of the relocation of households (supply side) on the labour market situation is opposite to the impact of the relocation pattern of firms (demand side). For the overall impact on the labour market one has to balance the relocation on the supply (households) and demand (firms) side.

So far, we discussed the balances between labour supply and demand on a regional level. In some regions one might expect that some inefficiencies on the labour market (market imperfections) decrease due to the introduction of the high speed train and in some other regions those market imperfections will increase. The net effect (benefit) for the national economy is uncertain and will differ according to the actual state of the economy (recession or high economic growth) in the period that the high speed rail link becomes operational. In general, national benefits occur if the net labour demand shifts in the direction of regions with relatively high unemployment levels.

The second effect that may occur is that commuters travel longer distances since the reach of the search areas of firms for new employees and of workers for new jobs is enlarged by the introduction of the high speed rail services. Again, the changes in commuter flows may lead to four impacts depending on the differences between the regional labour markets of regions connected by the high speed rail network. In table 4 and figure 2 (lower side) those relations are highlighted.

Table 4: Impacts of HSL construction on commuter flows between regions connected bv the HSL for four different vairs of regions

Destination region **Origin region**	**Excess supply of labour (unemployment): type A regions**	**Excess demand of labour vacancies): type B regions**
Excess supply of labour (unemployment): type A regions	Commuting between **A** regions Qualitative improvement of the national labour market The right worker on the right job	Commuting from **A to B** regions Both qualitative and quantitative improvement of the national labour market Decrease of the vacant jobs
Excess demand of labour (vacancies): type B regions	Commuting from **B to A** regions Deterioration of the national labour market Increase of the vacant jobs	Commuting between **B** regions Qualitative improvement of the national labour market The right worker on the right job

In the situation of commuting between regions with both high unemployment levels or both a large number of vacancies, the benefits are determined by the exchange of workers that results in finding the right worker at the right job. Thus, one could speak of a qualitative improvement on the national labour market. In the situation that commuters travel from regions with high unemployment levels to regions with high vacancy rates both qualitative and quantitative benefits occur. The opposite holds if commuting takes place between regions with high vacancy rates towards regions with high unemployment levels. The net result depends on the balance between those commuter flows. From a theoretical perspective it is expected that the net result will be positive.
Both effects on the labour market - the increase of the demand for labour near access points and the increase in the search area for jobs - will partly lead to a shift in existing market imperfections, and will be partly only distributive in nature. However, it is very difficult to clearly mark the division point between distributive effects and effects of a reduction of market imperfections. Only the latter effects should be taken into account in a national cost-benefit analysis. The regional distribution effects may only be taken into account when the regional distribution matters.

A similar discussion as above holds for the housing and real estate market. The demand for houses and real estate will increase in areas connected to the very high speed network and decrease in areas that are not connected (comparable with the situation sketched in table 3). Since households are more mobile than firms in particular the role of changing commuting pattems might be of importance here. People living in areas with a high pressure on the housing market are able to search for houses in other linked areas with lower pressure on the housing market within the same acceptable commuting time, compared to the situation before the HST-service became operational.

A final set of spatial economic impacts that may be induced by the construction of infrastructure in genera1 and very high speed rail links in particular, are cluster and image effects. If the accessibility of a city improves, firms from the region or from other regions (or even from abroad) may locate in that city. A concentration of firms may then attract new firms because of scale effects (cluster effects) or the presence of firms with a status (image effect). Not only firms with a high status may attract firms to locate in its surroundings. Also, the infrastructure project by itself may increase the status of a region as a whole and attract companies. Common examples are the attractiveness of sites near intemational airports (even for firms that do not use the airport itself) and the entrance of the Channeltunnel. In these examples the dynamic status of the infrastructure project attracts firms to affirm the status of the firm as being as dynamic as the infrastructure the firm is located nearby.

3. Effects of construction of high speed links: lessons from Japan and France

Although in many countries the construction of a HSL has high priority on the politica1 agenda, only few countries have an operational HST system. HSL experiences can be found in Japan, France, Germany, Belgium and Great-Britain. In Europe, France was the first country to construct a HSL. Since then, also in Germany (ICE) and in Belgium HSL have been constructed or HST runs on existing tracks. The opening of the Channeltunnel in 1996 included Great-Britain in the European network. The Netherlands followed in 1996 with the connection Amsterdam-Paris, although higher speeds are not (yet) reached on the Dutch part. Since the literature for Japan and France give insight into interesting experiences regarding spatial economic effects, only these will be discussed henceforth.

3.1 Japan, the Shinkansen network

Japan was the first country in the world to start the construction of a HSL, the so-called Shinkansen. In 1964, the first train rode with high-speed from Tokyo to Osaka and Nagoya. By now, a large number of Japanese cities is included in the Shinkansen network. The Shinkansen is famous for his speed, efficiency and comfort. Furthermore, Japan is a densely populated area, which creates a large potential market for the Shinkansen. A number of interesting (spatial) economic effects is observed after finishing the construction of the Shinkansen-network.

First, an increased growth of population has been observed in cities with a HST-railway station relative to other cities near the track and to the national average (Haynes, 1997 and Nordqvist, 1984, also see table 6). Moreover, a 22% higher growth of the population is found in cities with a railway station on the most important HST-connection (Tokaido Shinkansen) compared to locations without a station along this line (Haynes, 1997).

*Table 5: Comparison of cities with and without Shinkansen railway station, before and after opening**

Sector	Annual growth percentage before opening Shinkansen		Annual growth percentage after opening Shinkansen	
	Cities with a station	*Cities without a station*	*Cities with a station*	*Cities without a station*
Wholesale	12.9%	20.8%	11.6%	8.7%
Retail	10.1%	13.5%	10.0%	8.6%
Industry	13.7%	14.2%	9.5%	7.8%
Construction	13.8%	14.9%	8.0%	6.4%
Population	2.7%	3.4%	1.9%	1.6%

*growth indices are annual averages for the period 10 years before and 10 years after the opening and growth indices afier the opening of Shinkansen are lower than before the opening of the Shinkansen due to stagnating economy

Source: NEI, 1992

Secondly, the Japanese cities with a HST-station have demonstrated a higher growth in the number of firms than comparable cities without HST-railway stations. This also holds for employment (BCI, 2000). The index figure for growth of the number of firms in cities with a HST-connection has increased from 100 to 155 in the period of 1972-1985, while this figure has increased to 139 in other cities in this period. The increase in employment concentrated mainly in retail and wholesale, industry and construction; in these sectors growth was 16-34% higher in cities with stations compared to cities without stations (Haynes, 1997 and NEI, 1992, see table 5). These conclusions were confirmed by the results of Amano and Nakagwa (1990) who found a 26% higher growth of employment in cities with stations compared to cities without stations. These developments occurred mainly around the railway station; these locations became very attractive. However, it is not clear to what extent this growth was realised by the attraction of firms from the region (relocation) or by new firms (distributive versus generative).

Thirdly, changes have been observed regarding tourism. The number of tourist visits decreased in cities without a HST-railway station and increased in cities with a station. The number of hotels increased considerably in cities with a station. However, the number of ovemight stays reduced (Okabe, 1979).

Also, Nakamura and Ueda (1989) have done research on the relation between the presence of a railway station and expressway and four regional variables. Their conclusions are:

- The income per capita increased with 2.6% due to the presence of a station (6.4% due to expressway effects)
- Employees in retail increased with 0.4% due to station effects (1.2% due to expressway)
- The value of land for commercial services increased by 67% due to the construction of a Shinkansen-station
- Cities with a Shinkansen-station more often show an increase in population than cities without a station. This growth is stimulated by the presence of a expressway (see table 6).

Table 6: Change in population by presence of station and expressway (in number of cities)

	Increase in population	**Decrease in population**
With Shinkansen station		
• **With expressway**	17	10
• **Without expressway**	2	4
• **Total**	**19**	14
Without Shinkansen station		
• **With expressway**	13	16
• **Without expressway**	3	39
• **Total**	16	55

Source: Nakamura and Ueda (1989) and Haynes (1997)

Table 7: Information exchange industries employment growth (percent) in regions with vovulation increase. 1981-1985

	Shinkansen & expressway (%)	**Expressway only (%)**
Business services (total)	42	12
Information, investigation and advertising services	125	63
R&D and higher education	27	21
Political institutes	20	11
Other	57	28
Banking services	27	28
Real estate agencies	21	3
Average	22	7

Source: Nakamura and Ueda (1989) and Haynes (1997)

Table 7 shows that employment increased by 22% in the service sectors in regions with both a Shinkansen-station as well as a connection to the expressway network between 1981 and 1985, while regions without a Shinkansen-station (and connected to the expressway network) demonstrated a growth of only 7%.

In addition to this analyses, Sasaki et al. (1997) address the question wether the Shinkansen network has improved interregional equity by attracting econimic activity to peripheral regions that become connected to the network. They conclude that expansion of the Shinkansen-network seems to contribute to a very limited extent to regional dispersion of industry from developed regions to more peripheral areas. Many activities remain concentrated in large agglomerations like Tokyo and Osaka.

Regional dispersion can hardly be achieved, even not when a large network is constructed.

3.2 France, the TGV-network

The first HSL in France, between Paris and Lyon, was opened in 1981 and is completely integrated in the domestic rail system. Between 1980 and 1984, rail traffic between these cities increased with factor 2.5 in terms of number of passengers. This growth originates from air traffic (33%) and from road traffic (18%), 49% consists of new demand (Bonnafous, 1987). Then, the TGV-network has been extended so that cities like Grenoble, Lille and Nantes were connected to the TGV. The TGV is used in particular by business travellers (25%) and for tourist reasons (40%). Furthermore, in 15% of the cases in France, the HSL plays a role in the location choice of mainly regional offices (BCI, 2000). A HST-railway station also plays a role in the location choice (regional), but this factor is not decisive (NEI, 1992). Below, an overview is given of the most important relocation effects for households and firms.

3.2.1 Households

Recent experiences with the TGV illustrate the relocation effect of households. As a result of the TGV, people who work in Paris have the possibility to live in an attractive (green) environment on a relative short distance from Paris. In France, the use of the TGV has resulted in a rise in long-distance commuting (BCI et al., 1994). An example is the small city of Vendôme: the distance between Vendôme and Paris decreased from two hours and twenty minutes to forty-two minutes. Many Parisians buy a beautiful home in a nice environment for a reasonable price and on short distance from work (Nyfer, 1999). The consequences for land and house prices vary in different research. According to Van Dinteren and Fanceilo (1994), the construction of the station did not result in a rise in prices on the housing market. Haynes (1997) on the other hand observes a 35% increase in land prices. Apart from that, with the construction of a high-tech industrial site near the station (which is situated 5 kilometres outside the village), they tried to attract firms to Vendôme. This did not succeed, probably because Paris remained more attractive for firms due to the contacts within Paris (agglomerations of scale) (Van Dinteren et al., 1994). Also between Paris and Lyon an increase in commuting was observed. Many remained resided in Lyon, but commuted to Paris one or more times a week. In Lille, the number of residents increased due to the presence of a HST-railway station. Many who work in Paris, London or Brussels seem to reside in Lille (BCI, 1998).

3.2.2 Fims

The experiences in France show no evidence that the line Paris-Lyon has resulted in firms moving away from Lyon to Paris. The opposite trend is observed: the regional firms seem to take advantage of the fact that Paris is close-by (Bonnafous, 1987). As a result, more firms have located in the surroundings of Lyon. It is no longer necessary to have a business establishment in Paris. One effect that is observed concerns the increase in branch-offices of Parisian firms, particularly in the high-tech sector in the region Rhône-Alpes as a result of faster connections. The Bonnafous research (1987) also indicates that the presence of a HST-railway station does play a role in the regional location choice of a firm although this factor is not decisive.

The TGV in France has caused mainly relocation effects within the regions of cities with a HST-railway station (Nyfer, 1999). Near the stations, Lyon, for instance, was able to attract many firms from the regional competing cities like Grenoble and

Geneve. Also, firms from the direct surroundings located near the stations. The Part Dieu station (TGV-station in Lyon) developed into one of the main industrial sites in France. The amount of office space increased with 43% between 1983 and 1990 due to the large demand resulting from the improved accessibility (Haynes, 1997). The image-effect plays a role here: many large firms have offices situated here which attracts other firms (Plassard, 1989). It attracted both domestic investors as well as foreign investors. So, due to the TGV the Part Dieu district has become an attractive location for firms. However, it should be noted that the location was already attractive and had market potential before the construction of the TGV. This resulted in rising land prices, in a certain year even 40%. However, it seems to develop at the expense of the old centre of Lyon, where the development has stagnated.
The effects between the cities in the city network are not as large as anticipated. An example is Lille, which had high expectations of being the TGV nodal point of the East-West line (Paris-London) and the North-South line (Amsterdam-Paris). However, the results were disappointing; in 1996 only 15 new firms had located there and new office buildings near the Eurolille station stayed unoccupied (Nyfer, 1999). This is mainly due to the original situation with outdated, old industry, high unemployment, a low educated working population and low quality housing. Lille is expected to adjust and, in the long term, be able to benefit from the TGV by considerable relocation of firms. Nantes' distance to Paris became 2 hours (before it was 3 hours), however, relocation effects were hardly observed. Only some firms located in Nantes, while many firms that were active in the regional market stayed in Paris (Haynes, 1997).
Another effect that has been observed is the expansion of the labour market. As a result of the TGV, French firms have decided to close their branch-offices in surrounding cities and enlarge their main office in Paris (Nyfer, 1999). Employees, who were not able to work in Paris because of the high travel costs, now have the possibility to do so. Therefore, the branch-offices outside Paris are not needed anymore. This effect was observed in Le Mans, where a high decrease in employment occurred. The distance between Le Mans and Paris reduced from 2 hours to 1 hour. So, Paris benefits from the enlarged (labour) market resulting from the TGV while Le Mans experiences negative effects (in terms of employment). However, a different study states that land prices in Le Mans have increased with 100% in three years (Haynes, 1997). The TGV has contributed to this growth, but it is not the main explaining factor.
Furthermore, attracting firms appeared to be more difficult than expected. The village of Le Creusot expected to be very attractive for industrial firms by the construction of the TGV and started a major promotion campaign. A travel time of 1.5 hours to Paris would definitely make the industrial site successful. However, more than 6 years after the opening only two firms were located near the TGV-station (Plassard, 1989). One of these firms is a car rental company since the station is difficult to reach. The same situation occurred in Vendôme (see previous).
Particularly the region seems to benefit from the increased tourism; the hotels in places near Lyon show a rise in the number of overnight stays (Bonnafous, 1987). The number of hotels near the HST-station Part Dieu in Lyon increased considerably (while the number decreased near the old (not HST-) centra1 station), however, the number of ovemight stays increased (ECMT, 1994).

3.3 Lessons to be leamt from the Japanese and French experiences

Both the Japanese and the French studies showed that cities connected to the high speed rail network grow faster in population than cities without such a connection. Although the Japanese studies show that in particular large urban areas (such as Tokyo and Osaka) are able to attract firms and employment, these studies are less clear than the French studies on the differences in firm and employment growth between high speed rail connected cities. The Japanese studies more or less confirm that the demand on the labour market increases in cities with a Shinkansen connection compared to cities without such a connection. By connecting peripheral regions to the HST system some improvements in interregional equity can be achieved, but those effects are limited. In France the results are much clearer. Large urban areas where the pressure on the labour market is already relatively high, such as Paris and Lyon, are able to attract firms. Cities connected to the high speed rail network within a limited travel time distance from those major centres seem to be unable to attract firms. The scale economies keep the firms tied to the major urban conurbations. Regional offices of firms of which the headquarter is situated in the main conurbation are closed. The headquarters in the major conurbations can now cover those intermediate areas. Above a certain threshold travel time from Paris, other regional centres can develop. In France, Lyon is at a long enough travel distance to vitalise its new position in the high speed network to a considerable extent at the expense of former competitive regional centres such as Grenoble. The contacts between the major players in the field, Paris and Lyon, are strengthened by the opening of branch offices in the counter city. The tendency of firms concentrating in the major urban areas gives no further insights in the reduction of market imperfections. From a theoretical perspective, concentration of activities may even lead to a decrease in market imperfections, due to agglomeration advantages.

Considering the housing market the French studies- noticed an opposite relocation pattem compared to the relocation pattem they found for firms. Now the benefits are concentrated in cities within commuting distance from Paris, offering a nice green environment and houses at reasonable prices. Cities like Vendôme and Le Creusot that were unable to attract new firms were able to attract a considerable number of Parisians for their new residential areas. In our opinion this will lead to reduction of the existing imperfections on the housing markets in both the centra1 (shortage on the housing stock) as well as in the more peripheral regions (excess supply on the housing stock).

So spatial economic effects are observed by the introduction of the HSL. The connection on the HST-network contributes to the status of the larger urban agglomerations in particular, which attracts new activities (Van den Berg et al., 1998). Moreover, the outcome is largely dependent on other factors which determine the total location environment in a region (NEI, 1992). In addition, research has shown that, if the accessibility of a station is good, the benefits are the largest (Van den Berg et al., 1998). Poor entrance and exit transport should not leve1 out the travel time gains of the HST. The car is considered to be a proper addition to the speed and comfort of the HST. However, many studies conclude that the HSL in France (and Japan) have had only a limited effect on the spatial activity pattem of firms and households. This also becomes evident from studies on the reason for firms to relocate (Plassard, 1989). The firm strategy and the economic environment (mainly labour supply) mainly determine the location choice. Much depends on the economic potential of the region; if this potential is unfavourable, a HSL will have little effect.

4. Cost-benefit analysis on the HSL in The Netherlands

This section will discuss the CBA of the various HSL proposals in The Netherlands (see also figure 1): the HSL-South, the HSL-East and the Zuiderzee link (ZZL). First, the elements used in the analysis will be described and explained. Then, a table with the outcomes of the analysis will summarise the CBA. The first case, the HSL-South will be discussed in larger detail. For the other two cases, only the main differences with the CBA of HSL-South will be addressed.

4.1 CBA for HSL-South

The CBA for HSL-South has been carried out by a consortium of three Dutch consultancy agencies (BCI et al., 1994) in the period 1992-1994. Several variants have been considered. In this paper we confine ourselves to a comparison of two: the *base variant* and the *maximum variant*.

In the *base variant* neighbour countries invest in the HSL Paris-Brussels-Antwerp and the HSL Paris/Brussels-London via the Channel tunnel. The Dutch contribution remains limited to the rail investment program 'Rail 21', including an improved conventional connection with Antwerp. In The Netherlands, no high speed trains are in service.

In the *maximum variant,* The Netherlands invests in dedicated HSL so that the HST runs from Paris to Amsterdam. The improvements in the rail network in the neighbour countries are the same in both variants. In the maximum variant, on the Dutch part the largest travel time gains are 44 minutes, of which 21 minutes on the connection Amsterdam-Rotterdam. The economic setting is the CPB (Dutch Centra1 Planning Agency) European Co-ordination scenario (medium economic growth). The CBA is calculated from two different perspectives: the *project* leve1 and the *national* level. The *project* leve1 assesses the construction of the HSL without making a distinction between the countries that receive the benefits. The *national* leve1 only considers the benefits relevant for The Netherlands or for persons with a Dutch identity.

The effects included in the CBA are changes in:

1. Exploitation balance;
2. Travel time;
3. Travel costs;
4. Surplus;
5. Efficiency;
6. Environment;
7. Traffic safety.

These effects are compared to the investment costs of the HSL after which the project can be assessed. The indirect economic effects are not included in the CBA, but are addressed separately (see section 5). The CBA has been carried out for the period *2003-2030.*

The *construction costs are* determined on the base of information provided by Projectbureau HSL. Discounted to 1993, starting with a discount rate of 5%, the market value of the construction costs is calculated at *f* 4,143 million (guilders 1993, 1 euro is 2.2 guilders). These construction costs then have to be corrected for the cost savings resulting from the postponement of investments in the existing infrastructure. This postponement is possible because the existing infrastructure will be less used if the HSL is constructed. The market value of these benefits is *f* 497 million guilders (guilders 1993, discount rate 5%). The net market value of the construction costs of the HSL is then *f* 3,646 million.

The *exploitation result* is determined on the base of information about the expected passenger flows in 2003, provided by the Projectbureau HSL. The total flow of passengers with a Dutch origin or destination in 2003 is estimated to be 9.5 million, of which 3.2 million (34%) international passengers and 6.3 million national passengers. It is expected that the international flow grows annually by 2.5% in the period 2003-2015, and by 1% in the years thereafter. The national traffic is expected to grow by 0.8% per year for the whole period 2003-2030. Other interesting aspects that are taken into account considering the passenger flows are given in table 8.

Table 8: Predictions of the passenger flow with a Dutch origin or destination on the HSL-South (x 1 .000)

	International	National
Business	1,240	**1,800**
Non-business	1,960	**4,500**
Modal shift	2,130	4,700
• **Train**	720	600
• **Aircra**	540	4,100
Generated Aircraft	1,074 870	1,600 --

The annual exploitation result of the HSL is balanced with the exploitation result in the base variant (no HSL in The Netherlands). Discounting until 2030 with a discount rate of 5% results in a market value in 1993 of the net exploitation result (HSL variant compared to base variant) of *ƒ* 1,390 million (including V.A.T.).
The *travel time gains* will not occur on every track. In particular on the Amsterdam-London part and the Rotterdam-London part, travel time increases will occur, due to the modal shift from aircraft to HST. The applied values of time for the different groups of travellers are given in table 9.

Table 9:Valuation of travel times for different groups of passengers (in guilders per hour)

	Aircraft	Car	Train
Business	90	70	70
Non-business	18	14	14

An important part of the travel time gains will be realised by the (relatively large) group of travellers in domestic traffic. On a project level the market value is calculated at *ƒ* 1,575 million and on a national level this is *ƒ* 1,180 million[2].
The market value of the *travel cost savings* (the difference in travel costs due to the modal shift) on a project level is *ƒ* 1,526 million. For The Netherlands this means *ƒ* 763 million. The most important travel cost gains are made by former aircraft travellers.
Next to travel time gains and travel cost savings the *surpluses* for additional travellers are calculated, based on the assumption that the fictive saved generalised costs are the surpluses. It is common use to take half of the actual generalised costs as the surpluses for additional travellers (the so-called 'rule of halve'). The market value for the project level is *ƒ* 987 million and for the national level *ƒ* 549 million.
The *efficiency gains* taken into account in this CBA are benefits made by the possibility of working in the train and are therefore only determined for business

[2] Of the international travellers it is assumed that 50% has the Dutch nationality.

travellers[3]. The market value of the calculated efficiency gains on the project level are *f* 924 million and for The Netherlands f304 million. It should be emphasised that these gains are minimum estimates, since the efficiency gains for non-business traffic receive no attention and the efficiency gains are limited to working time gains.
The effects of the HST on the *environment* concern noise nuisance, fragmentation of the landscape and the emission of greenhouse gasses. Only the latter is taken into account in the CBA of the HST-South. The changes in the total emission of CO, CO_2, NO_x, C_xH_y, SO_2 and AERs are based on traveller kilometres (modal shift and generated flows). At the project level the environmental costs are *f* 43 million and for The Netherlands *f* 12 million.
Finally, concerning *traffic safety*, on the basis of the number of deaths, wounded and material damage accidents per person kilometer in road, rail and air traffic, the change in the number of persons that die or are wounded in traffic after the construction of the HSL is determined. The market value of the benefits of the HSL is on the project level *f* 293 million and at a national level *f* 169 million.

Table 10: Summary valuation effects HSL-South

Effects	NPV of costs (-) and benefits (+) until 2030 in guilders of 1993 (mln. Guilders)	
	Project level	The Netherlands
Exploitation balance	+ *f* 1390	+ *f* 1390
Travel time gains	+ *f* 1575	+ *f* 1180
Travel cost savings	+ f 1526	+ f 763
Surplus additional travellers	+ *f* 987	+ *f* 549
Efficiency gain	+ *f* 924	+ *f* 462
Environment	+ f43	+ f 12
Safety	+ *f* 293	+ *f* 169
Postponement investments in Rail 21	+ *f* 497	+ *f*497
Total benefits construction HSL	+ *f* 7235	+ *f* 5022
Construction costs HSL	- *f* 4143	- *f* 4143
Benefit/cost (B/C) ratio	1.75	1.21
B/C ratio construction costs +25%	1.40	0.97
B/C ratio traffic size –25%	1.34	0.94
B/C ratio construction costs +25%, traffic size –25%	1.07	0.75

The indirect economic effects of the HSL-South will be addressed in section 5.
Table 10 summarises the above mentioned effects. From the table we may conclude that the benefits of the HSL-South are larger than the costs. It should be noted that regarding the benefits, the decrease in human suffering from the decrease in accidents, other efficiency gains besides working time gains and indirect economic effect are not included in the CBA. Also, on the cost side, noise nuisance and fragmentation of the landscape are not taken into account.
● Finally, the changes in the B/C ratio with higher construction costs and fewer travellers are looked at. If the construction costs are 25% higher and the traffic size is

[3] Other efficiency gains not taken into account are: the efficiency of service, services at the edges of the day, the reliability of services, and the location of stations towards origins and destinations.

25% lower, the benefits are (somewhat) larger than the costs on the project level, but on the national leve1 the costs are higher.

4.2 CBA for HSL-East

The Dutch Centra1 Planning Agency has performed a CBA for the HSL-East (2000), which concerns an improvement of rail between Utrecht and the German border (about 75 kilometres) and will connect The Netherlands to the German high speed rail network (see figure 1). In this research, three altematives are distinguished: the base altemative (maximum speed 140km/h), the 200 km/h altemative and the 300 km/h altemative. The CBA is closely related to the recommendations from the Research Economic Effects Infrastructure (OEEI, Dutch Ministry of Transport, 2000) and forms the first integral application of the OEEI rules (OEEI gives the official CBA guidelines that have to be applied for large infrastructure projects in The Netherlands). The CBA includes all social advantages and disadvantages: direct economic effects, environmental effects, spatial and macro-economie effects of the construction are addressed.

This immediately highlights the main differences between the CBA of HSL-South and HSL-East: the CBA of HSL-East does include indirect economic effects in the analysis (employment new firms, trade flows), as well as the macro-economie implications of these effects. The indirect economic effects of HSL-East are described in section 5 of this paper.

The CBA has been carried out for the period 2008-2033 (in this period the link is operational). The travel time gains are relatively smal1 (11 minutes in case of the 200 km/h variant and 14 minutes in case of the 300 km/h variant) due to the smal1 length of the link in The Netherlands (75 km). The modal shift and generation of travellers is relatively small. In 2020 the 200 km/h variant will result in 1.9 million additional travellers compared to the base variant. Of those 1.9 million travellers 1.5 million (80%) concerns a modal shift from the car and 0.3 million (16%) concerns additional travellers. The modal shifts from aircraft and touringcar are relatively small. The 300 km/h variant adds 2.1 million travellers to the base variant. Also, in this variant it mainly concerns a modal shift from the car (1.7 million or 80%) and to a lesser extent additional travellers (0.35 million or 17%).

Compared to the HST-South, some conclusions can be drawn. The total volume of additional travellers (modal shift and generation) of the HST-East is about 1/3 of the flow of the HST-South. The share of the generated flow is considerably lower than the share of the generated flow of the HST-South (28%). The share of the business travellers (11%) is considerably lower compared to the HST-South (30%). Also, the share of the intemational travellers (3%) is considerably lower compared to the HST-South (48%). Two explanations are given for those differences. First, the destinations in the Ruhr area are much more dispersed compared to the destinations Brussels, Paris and London and, second, most improvements in the HSL-East (direct connections, and improved comfort) are already realised in the base variant. The valuation of travel time differs per motive: 30.9, 14.6 and 9.0 guilders per hour for business travellers, commuters and 'other motives', respectively.

- The CBA of HSL-East also includes environmental effects as in the CBA of HSL-South, only here, also local effects such as segmentation of the landscape, the demolition of houses, destruction of nature, etc. are included in the analysis. However, financial valuation of these effects is problematic.

Table 11 gives an overview of all the benefits and costs of the HSL-East as calculated by the CPB. From the CBA, the CPB concludes that the project is not profitable: the costs are expected to be larger than the benefits. The main reason for the limited benefits compared to the costs is that the extra travel time gains on the relatively short Dutch part are smal1 (an investment of *f* 4 - 7.5 billion results in a travel time gain of 11 – 14 minutes).

Table 11: Outcomes CBA for the HSL-East (200 km/h and 300 km/h) compared to base-alternative in NPV 1997 (in billion guilders)

	Financially	**Concerns**
BENEFITS		
Direct effects		
Exploitation benefits	*f* 0.2 - 0.4	Extra ticket revenues
Benefits for travellers	*f* 0.3 - 0.7	Travel time gains and comfort improvement minus ticket cost increase
Indirect effects		
Location / trade flows	*f* 0.1 - 0.3	Scale, efficiency and location effects
Macro-economie implications in exploitation phase	*f* -0.1 - -0.2	
Environment: avoided emissions	*f* 0.0 - 0.03	Substitution car/ airplane, partly compensated by extra traffic
Total benefits	*f* 0.6 - 1.2	
COSTS		
Infrastructure investment	*f* 3.1 – 5.8	
Infrastructure maintenance	*f* 0.9 – 1.6	
Exploitation costs	*f* 0.2	
Total costs	*f* 4.2 – 7.6	
Financial balance (benefits – costs) [1]	*f* -3.1 - -6.9	
Internal rate of return	*	Has no practical meaning, because the benefits were not larger than the costs in a single year in that period
PM POSTS		
Distributive effects (between regions)	PM 1	Slight shift industry to HSL-East corridor
Landscape and nuisance	- PM 2	Diverse, negative

[1] The lowest respectively the highest costs do not always go with the lowest respectively the highest benefits, so the balance does not automatically follow from the figures

4.3 CBA for ZZL

The CBA for the Zuiderzeelink has been canied out by the NEI (2000). In the analysis, the so-called base altemative is compared to the project altemative. The base altemative is the situation in 2010 where the planned infrastructure projects of the Dutch rail investment program 'Rail 21' are included. The NEI has calculated 6 project altematives that differ conceming trace and used technique. Here, only 3 altematives, which we consider to be the most relevant, will be discussed: the Zuiderzee link with an Intercity service (ZZL-IC), a HST service (ZZL-HST), and a magnetic levitation service (ZZL-MZM). Three economic growth scenarios (Divided Europe, European Co-ordination and Global Competition), developed by CPB, form the background of the CBA. In order to limit complexity, only the medium-growth scenario (European Co-ordination) is presented.

The CBA has been carried out for the operational period 20152040. The Zuiderzee link is different compared to the HSL-South and HSL-East since it concerns the construction of a new link – a short cut – in the existing rail network, whereas in case of the HSL-South and HS-East it concerns improvements of existing tracks (see figure 1). No wonder that due to the short cut and given the travel time in the base variant of 124 minutes, on the link Amsterdam Schiphol Airport – Groningen the travel time gains are considerable. The travel time gains are 35, 51 and 64 minutes in case of an Intercity, HST and Magnetic Levitation service, respectively. However, as shown in table 12, also the construction costs differ considerably.

Table 12: CBA outcomes (EC-scenario, mln guilders, NPV 2010)

	ZZL-IC	ZZL-HST	ZZL-MZM
Benefits			
Direct effects			
Exploitation revenues	556	912	2,464
Travel time gains	795	1,006	2,276
Indirect effects			
Labour market	286	511	909
Housing market	nihil	nihil	nihil
International	0	366	565
Regional distribution	PM	PM	PM
Other indirect effects	PM	PM	PM
Total benefits	1,638	2,793	6,214
Costs			
Direct effects			
Investments. Infrastructure	5,060	7983	12947
Rest value infrastructure	-596	-940	-1524
Maintenance and exploitation costs	470	367	1992
External effects			
CO_2 and NO_x	33	67	311
Other external effects;	PM	PM	PM
Decrease congestion	0	0	0
Total costs	**4967**	**7477**	**13726**
Balance	**-3329**	**-4684**	**-7511**
Uncertainty margin	5-10%	10-15%	10-15%

The exploitation result has been calculated in a way similar to the HSL-East, with exception of the 'comfort' aspect, which is not taken into account. Unfortunately, the shares of various types of travellers, such as business travellers and commuters, are not specified in the final report.

In this CBA, much more than in the HSL-South and East, the indirect effects play an important role. Labour market effects, housing market effects, international effects, macro-economie implications and other indirect effects such as cluster and scale effects and consumption effects are taken into account (see section 5). Also the environmental effects are included extensively in the analysis. Nature, landscape, land use claims, noise, soil, water, living environment, energy use and emissions are all considered. For some elements, a quantification and monetisation is possible, other aspects of the environment are qualitatively estimated. The latter category is included as a PM post.

The NEI also considers the possible decrease in congestion on the road network as an element in the CBA.

Table 12 presents an overview of all the aspects included in the CBA. The NEI concludes that none of the project altematives is profitable. The figures for the balance show this. Both the costs as well as the benefits increase when the altemative is faster. However, the balance of the faster altematives is more negative than the slower altematives.
The CBA of the Zuiderzee link has led to fundamental debates about the interpretation of the indirect effects. The NEI acknowledges in their final report that most uncertainties are related to this interpretation. To which extent can we speak of welfare gains that should be taken into account in the national cost-benefit analysis, and to which extent are they just regional distribution effects which should not be taken into account in the national CBA? In an altemative CBA, researchers from The North arrive at a positive result of the national CBA, using a longer operational period (50 years in stead of 30) and a different interpretation of the indirect impacts. Since they are using a longer operational period they add no rest value of infrastmcture in their CBA. Given the importance of indirect impacts, section 5 is dedicated to those impacts (see also section 2 for the theoretical problem identification).

5. The expected spatial economic impacts of HSL in The Netherlands

In this section, the expected indirect economic effects of the construction of HSL in The Netherlands will be discussed. First, some results from research on the HSL-South and the HSL-East will be addressed. Then, the effects of a connection between The Randstad and Groningen will be discussed in more detail.

5.1 Effects of HSL-South

The indirect impacts of the HSL-South are not integrally dealt with in the CBA. The indirect effects are not found in the final CBA table (see table 10). Nevertheless, they are discussed in great detail in the final report (more than half of the pages of the final report concern the indirect effects).
The indirect effects are discussed for business and non-business travellers. Considering *business travellers*, the indirect effects are mainly caused by the relative improvement of the intemational competitive position of The Randstad[4]. The expectation is that the competitive position of the to the HST-network connected cities within The Randstad will be further strengthened compared to the Dutch cities that are not connected to this network. Nevertheless, it is expected that the construction of the HSL-South will hardly result in different location behaviour of intemational firms. The HSL is considered to be an interesting circumstance but is not decisive for location decisions of foreign and national firms. For the Dutch economy six indirect impacts are researched by rather qualitative approaches, such as literature surveys. These six indirect effects and the volume of their impacts are:

- International relocations: 830-1,660 jobs created by intemational relocated offices (European headquarters, sales offices and back offices) in The Randstad.
- Securing existing jobs: due to the construction of the HSL-South 35,000 existing jobs – in the business service sector - are secured in The Randstad. It is argued that those jobs might be in danger without the HSL, due to a decrease in the relative competitive position of The Randstad compared to other European cities

[4] The Randstad is defined as the urban agglomeration in the western part of The Netherlands, covering the main cities of the country: Amsterdam, Rotterdam, The Hague and Utrecht (see Figure 1).

that are linked to the HST-network. However, the analytical prove of this argument is absent.

- The impact of the additional spending of travellers towards The Netherlands on employment is marginal and compensated for by the spending of Dutch travellers abroad.
- The increase in jobs due to increased trade is estimated at 200 jobs.
- The HSL does offer a flexible functioning of the labour market, particularly for the segment of the labour market with the highest mobility: the middle to higher educated (NEI, 1992). Due to the HSL, the north and south part of The Randstad can function as one labour market. Also, the possibility of long-distance commuting (between The Randstad and Brussels) occurs. However, those labour market effects are not quantified.
- The HSL-South supports – as a feeder for intercontinental flights – the mainport development of Amsterdam Schiphol Airport. Also this impact is not quantified.

Considering non-business travellers none of the impacts are quantified. However, the CBA states the importance of the HSL-South for the international position of Amsterdam as a major tourist centre. Also for international social trips (visit of family and friends) the HSL might contribute.

The final conclusion on the impacts of indirect effects is that there are a number of positive impacts to be expected. However, since they are not measured, quantified, and included in the final CBA, their formal role in the political decision making process has been limited.

5.2 Effects of HSL-East

The idea that the indirect impacts are not directly related to the infrastructure project and thus should not be an integral part of the CBA, is left by the new official guidelines for CBA of infrastructure projects in The Netherlands: the already mentioned OEEI-guidelines (Dutch Ministry of Transport, 2000).

Recently, research has been carried out on the indirect spatial-economie effects of the HSL-East (BCI, 2000). Besides the changes on the office and firm market, the CBA offers also insight in additional import and export due to business trips, the effects for commuting and other effects. Figure 3 shows the various indirect effects.

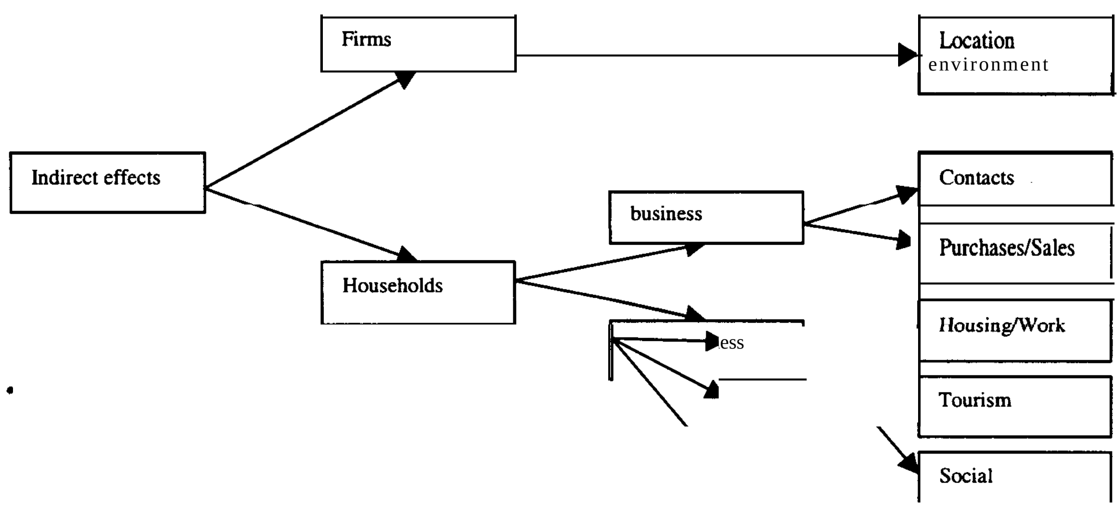

Figure 3: Overview of the indirect effects
Source: BCI, 2000

The main cities on the link - Utrecht, Arnhem and Amsterdam - are expected to create 50-80 additional jobs in the office sector (European headquarters, back offices, and sales offices) in 2010. This concerns the difference between the base variant (140 km/h) and the fast variants (200 - 300 km/h). This impact is rather smal1 due to two effects. First, also the 140 km/h variant offers HST services so there is no additional improvement in the quality of service (connections and comfort). Second, the travel time gains between the base variant and the faster variants are rather limited (between 7 and 11 minutes).
The issue of how to distinguish between national welfare benefits and regional distributive effects has not been subject of the HSL-East study. Although scale (cluster) effects and image effects are discemed they are supposed to be of a marginal impact and are thus neglected.
The impact on households is hardly studied. It is only noted that the construction of the HSL-East might lead to a better functioning labour market, due to an enlargement of the labour market area (larger commuting distances become acceptable). Furthermore, migration to residential areas with lower house prices and costs of living are to be expected. However, none of these aspects are quantified, neither as the possible changes in land prices or prices for houses and real estate.
In the CBA attention is paid to the impact on tourist expenditures. However, since it is expected that more Dutch travellers travel abroad than foreign travellers visit The Netherlands, it is well possible that the net result will be negative.
Given the above overview we may conclude that the indirect effects are only partially taken into account in the CBA. The major omission is an analysis of the welfare gains that might occur due to the relocation of firms and households.
The effects that are analysed suggest that the impact of indirect effects is rather modest.

5.3 Effects of the Zuiderzee Link (ZZL)

A number of studies is available on the indirect impacts of the construction of the Zuiderzee link. Starting points and assumptions vary in the different studies (for instance, the transport model used, the type of rail system - Intercity, high speed train, Maglev - researched, the project altematives, et cetera) which result in major differences in the outcomes. Yet, the results give insight in the expected welfare gains due to the relocation of firms and households
One of the first studies on the spatial-economie effects of the construction of a fast rail connection between The Randstad and The North of The Netherlands was done by Evers et al. in 1988. It concerns a qualitative research on the spatial economic effects of a HSL between Amsterdam and Groningen (see figure 1), which was supposed to be connected to Hamburg in the north of Germany. However, it does not start with a complete HSL, but with a conventional (average speed of 100 km/h) and a faster conventional train (160 km/h). In this study, the employment effects are based on a potential model for two scenarios for The North and the rest of The Netherlands. The estimated effect for The North is 300 to 800 jobs and for the rest of The Netherlands 1,400 to 4,400 jobs, dependent on the economic growth scenario. Also, the consequences for households have been investigated with a similar potential model. These results show that cities hosting the last stops of the train loose inhabitants and cities with in-between-stops gain inhabitants.
The CPB (1999) partly uses the outcomes of the study of Evers et al. (1988) in their calculations of the number of additional jobs, however, adjusted for other assumptions. For instance, in the CPB analysis the HSL-South, HSL-East and the

Hanze link (another improvement of the rail network between The Randstad and The North) are taken as given, whereas Evers et al. do not take these developments into account. Compared to Evers et al. this leads to a reduction of the employment effects and relocation effects found in the CPB study (also see table 13).

Table 13: Estimation of the indirect effects of the ZZL by the CPB

	Evers et al.	HSL	Maglev
Employment North-Netherlands (in jobs)	300-800	200-500	600- 1,200
· By firms locating		150-400	400-800
· By migration		50-100	200-400
Inhabitants North-Netherlands (Groningen, Friesland, Drenthe)		250-600	l,lOO-2,100

Source: CPB. 1999

Table 13 shows that the expected employment effects of a conventional HSL are more likely to be a few hundred jobs than a few thousand jobs. Furthermore, the construction of the ZZL will increase the number of inhabitants of The North. The construction of a Maglev has larger consequences for both the housing market as well as employment, due to reducing travel times and increasing possibilities for in-between-stops (CPB, 1999) (although the period of the effects is not clear (in another publication these effects will occur in 10 years)).
A recent study (BCI et al., 1999) assumes the construction of the Maglev. Also in this study, scenarios are used: a maximum (starting point: utilisation of all opportunities by The North and Flevoland for both housing as well as working) and a minimum (all threats become reality for these regions) scenario. The conclusion of the study is that the additional attractiveness of the Maglev for The Netherlands is limited. Distributive effects dominate generative effects. The Maglev strengthens the attractiveness as business location and the residential environment of The North and Flevoland. The Randstad experiences limited advantages of HSL construction and relatively little disadvantages. For instance, the housing possibilities for people who work in The Randstad increase and the labour market enlarges. A disadvantage would be the relocation of firms. The North experiences advantages and relatively little disadvantages from the Maglev. New inhabitants and new firms will move to The North and also existing firms can be maintained. According to this study, a quantitative estimation gives the following idea (see table 14) with the CPB results as a comparison. The estimations of BCI are additional effects of the Maglev (additional to the development in the EC-scenario of CPB), while the CPB starts with the potential model (and thus the results of Evers et al., 1988). Particularly the intemational effects show large differences. It appears that large differences exist in the expected effects, which can also be explained from the different starting points.
In the CBA of the NEI (see section 4.3), a maximum employment gain of 5,000 jobs in 2020 is used (TNO-Inro et al., 2000) which is more in line with BCI et al. (1999) than with CPB (1999) (see table 14).

Table 14: Comparison of studies on Maglev; effect over the jìrst 10 years of exploitation of The North of The Netherlands

	CPB (1999)	BCI et al. (1999)
Employment North	600- 1,200	3,000-8,000
Inhabitants North	1,100-2,100	7,000-15,000
Houses North	?	3,000-6,000

Source: CPB (1999) and BCI et al. (1999)

The conclusion is that the connection between Amsterdam Schiphol Airport and Groningen will generate overall positive spatial-economie effects, however, mainly distributive of nature. Note that limited insight exists on the spatial differentiation.

The official CBA of the Zuiderzee link has been carried out by NEI (2000) and is based on several underlying reports. The indirect impact study has been carried out by a consortium of three consultancy agencies (TNO Inro et al., 2000). The following aspects are taken into account:

1. Labour market effects
2. Housing market effects
3. Other effects
   - International relocation of firms
   - Macro-economie feed backs
   - Scale and cluster advantages, expenditure effects

We will discuss the first two aspects in detail.

Ad 1: *Labour market effects.* The Zuiderzee link leads to competitive advantages (faster connections, lower transport costs) for firms located in regions connected to this link. This leads to an increasing demand for their products, and by that to an increasing demand for labour, at the expense of employment in regions which are not connected to this link.

Basically, these are distribution impacts that should not be included in the national CBA. However, these impacts might have policy implications. One of the targets of the Dutch govemments is to stimulate economic growth in The North. A redistribution of employment in the direction of The North will be seen as a positive development from a policy perspective.

However, next to these distribution effects, also efficiency improvements - national welfare gains - might occur (we refer to the theoretical discussion of section 2). Two efficiency impacts are analysed:

- A better match between demand and supply on the labour market due to an enlargement of the labour market (improvement long distance commuting).
- A better fit of demand and supply within regions due to the redistribution of firms and households (net results of migration between regions with different unemployment and vacancy levels).

In the CBA the impact of the first effect (better match) is assumed to be marginal. It is assumed that most long distance commuters are highly educated. However, the model used (a spatially genera1 equilibrium model) shows that in all regions the number of jobs for highly educated employees increases and that there is a balance between demand and supply at this level. Thus, welfare gains do not occur. Considering the second effect (better fit), in the CBA it is argued that not the whole net result of 'better fits' concerns efficiency gains. First, as already mentioned, the regional demand and supply of higher educated are expected to be in balance. Thus the highly educated are not taken into account. Second, a better fit not increasingly leads to a reduction of unemployment. Also crowding out might occur. In The Netherlands, 36% of the newly created jobs are taken by former unemployed. When it is assumed that this 36% also holds for the fulfilment of existing jobs left by workers that improved their labour market position the efficiency gains will then be 59% (((1-0.36) * 0.36) + 0.36 = 0.59) of the total net better fit of supply and demand measured over all regions.

In The Netherlands, in particular on this issue, a hot debate started on the interpretation of these labour market effects. Some argue that, due to a more efficient labour market, there are large benefits to be expected of this connection between an area with a high vacancy rate (The Randstad) and an area with high unemployment levels (The North). They disagree with the results of the official CBA, by stating that large groups of long distance commuters are not highly educated, and that also unemployed workers will find jobs. On the other hand, they claim smaller crowding out effects by stating that the interregional distribution concerns all sectors and not just business services as is assumed in the official.
Ad 2: *Housing market effects.* The Zuiderzee link enlarges the regional housing market and this leads to a better match between demand and supply. In the present situation there is a very high pressure on the housing market in the Amsterdam region, whereas the housing market in Groningen is rather relaxed. The price of an average intermediate house in Amsterdam is about 2.3 times as high as in Groningen. Not only The North but also the intermediate regions, such as the province Flevoland, offers commuters to The Randstad good opportunities to buy a house for a reasonable price in a green environment.
In the official CBA the above situation is acknowledged. However, in the model the regional price effects were assumed to be neutral on the national leve1 and an additional questionnaire among housebrokers did not provide the required information to assess the impact of HSL construction on housing prices. Thus efficiency gains on the housing market are not included in the official CBA.
Also this has lead to disagreement. Some argue that improvements in the quality of the residential areas (both better/larger houses as well as greener surroundings) and the lower construction costs in areas outside The Randstad should be taken into account as a benefit in CBA.
Ad 3: *Other effects*: The international relocation of firms is calculated by a genera1 equilibrium model at the European leve1 (Bröckner in TNO Inro et al., 2000). In this model travel time gains result in a more competitive position of regions. Although some intemational relocation occurs, most of the impacts (70%) are in favour of The Randstad area. In this area the crowding out effects may be assumed high. The expected number of jobs in The Netherlands due to the intemational relocation of firms is presented in table 15 (see section 4.3 for the explanation of the CBA).

Table 15 Expected number of jobs due to intemational relocation in The Netherlands for three different variants

	ZZL-IC	ZZL-HST	ZZL-MZM
Number of jobs	0	500-600	800-1,100

The macro-economie feedback is not calculated. Other aspects that were not included are: cluster and scale effects, second order effects, image effects, and the effects of a reduction of congestion on the road, in particular in The Randstad area.
Remarkable is that, whereas the official CBA shows that all variants lead to a negative balance, others come to a positive balance. The difference in results is only partially based on different calculations of the investment costs and different appraisal periods. The major differences in the results, however, are explained by different interpretations of the indirect impacts of the project.

6. Concluding remarks

This paper focuses on the economic impacts of the construction of high speed rail links. Special emphasis is laid on the indirect economic effects resulting from high speed trains. An overview of approaches used to evaluate the impact of infrastructure projects in several countries shows that most differences and difficulties arise on the topic if and how to measure and evaluate these spatial economic impacts. These spatial economic effects concern changes in location behaviour of both firms as well as households caused by the construction of a new fast connection (intra-regional, inter-regional and intemational effects). In the paper a theoretical overview of relocation and commuting pattems is given.
To gain some insight in these spatial economic effects first empirical evidence from France and Japan is presented in section 3. Of course, the scale and size of such experiences is not directly comparable to the Dutch situation, but some important insights can be gained from the ex-post experiences elsewhere. These experiences leam that a HSL increases the attractiveness of employment areas near the stations; however, this development can be at the expense of sites further from the station. In Lyon, the Part Dieu station has developed in an attractive office location, while activities near the old centra1 station have reduced. Besides changes within regions, also changes between regions may occur. The spatial economic research shows evidence that these effects are normally smaller than the effects within regions. Smaller cities connected to the HST-network, become attractive residential locations. For firms, these locations are usually less attractive (see the Vendôme-experience in France). Furthermore, the Japanese experiences show that both the population and the number of jobs increase in cities connected to the Shinkansen-network. We can conclude that the attractiveness of a city increases by the construction of a HSL. However, the effects are limited, especially for the more peripheral regions.
Next to this discussion about experiences in France and Japan, three Dutch ex-ante evaluation studies on planned extensions of the high speed rail network are presented. Section 4 discusses the results of those studies in general. In section 5 special emphasis is laid on the spatial economic impacts, in particular to the discussion on expected national welfare gains of the relocation of firms and households in case of the ZZL connecting Amsterdam with The North of The Netherlands.
The HST-South is considered to be important for the competitive position of The Randstad. In addition, the functioning of the labour market will become more flexible. However, no effort is made to analyse the changes in the location behaviour of firms and households, so that increasing employment will only occur to a limited extent. The same holds for the HST-East: only limited additional effects can be expected. Finally, the estimated effects of the construction of the ZZL are included in this paper. The overview shows that the absolute number of relocations of firms and households is rather large in the official CBA. However, they are mainly interpreted as distributive effects. The expected welfare effects are limited. However, this result has led to strong disagreement. An altemative CBA is presented in which in particular the indirect effects received major attention. This has led to the remarkable situation that, whereas the official CBA shows that all the variants are far from profitable, due to a different interpretation of the welfare effects of the relocation of firms and households, the altemative CBA shows that the most expensive, magnetically levitated variant is most profitable. This once more stresses the importance to achieve more knowledge on how to deal with indirect spatial economic impacts in evaluation approaches of major infrastructure projects.

The question if we should deal with those impacts, or ignore them because they can be seen as double counting of already measured impacts such as the reduction of generalised travel costs, can be answered to a large extent.
We should take them into account as far as market imperfections occur in the transport or other markets. But the present models used do not yet give unambiguous answers on how to address these problems.
Ex ante experiences in The Netherlands show that the final result of a CBA strongly depends on the interpretation of the relocation of firms and households. However, ex post research in France and Japan provides evidence that the spatial economic impacts should not be exaggerated.

Literature

Amano, K. en Nakagawa, 1990, *Study on Urbanization Impacts by New Stations of High-speed Railway*, Conference of Korean Transportation Association, Dejeon City.

Berg, L. van den en P.M.J. Pol, 1998, *The European High-Speed Train and Urban Development; Experiences in fourteen European urban regions*, Ashgate, England.

Bonnafous, A., 1987, The regional impact of the TGV, *Transportation*, 14, pp. 127-137.

Bristow, A.L. and J. Nellthorp, 2000, Transport project appraisal in the European Union, *Transport Policy*, Volume 7 (1) 2000, pp.51-60

Buck Consultants International (BCI), Bureau voor Economische Argumentatie (BEA) en Nederlands Economisch Instituut (NEI), 1994, *Nieuwe HSL-Not: de economische effecten*, deelrapportage 13, Den Haag.

Buck Consultants International (BCI), 1998, *The Impact of the High Speed Train on Urban Centres, Evaluation of European case-studies,* Den Haag.

Buck Consultants International, DHV en MVP, 1999, *Zuiderzeelijn: onderzoek naar de mogelijkheden van een magneetzweejbaan in een PPS-constructie.*

Buck Consultants International, *2000, Indirecte ruimtelijk-economische effecten van de Hoge-Snelheids Lijn Oost (HSL-Oost),* Nijmegen.

CPB, 1999, *Ruimtelijk-economische effecten van de Zuiderzeelijn* (notitie aan de minister van Verkeer en Waterstaat), Den Haag.

CPB, 2000, Kosten-batenanalyse van HSL-Oost infrastructuur, werkdocument no. 128, Den Haag

Dinteren, J. van en M. Fancello, 1994, The High Speed Train System, Urban Developments and Real Estate, *Tijdschrift voor Economische en Sociale Geograjìe,* Volume 85, Nr 2, pp. 165-170.

ECMT, 1994, Regional Policy, Transport Networks and Communications, Parijs.

Evers, G.H.M., P.H. van der Meer, J. Oosterhaven en J.B. Polak, 1988, *Locational impacts of a high speed train between Amsterdam and Hamburg,* Rijksuniversiteit Groningen, Institute for Economic Research, Research Memorandum 241.

Hayashi, Y. and H. Morisugi, 2000, International comparison of background concept and methodology of transportation project appraisal, *Transport Policy*, Volume 7 (1) 2000, pp.73-88

Haynes, K. E., 1997, Labor markets and regional transportation improvements: the case of high-speed trains, an introduction and review, *Annals of Regional Science,* Volume 3 1 (1), pp. 57-76.

Healey&Baker, 1990-1996, *European Real Estate Monitor,* Healey&Baker, London.

Lee, D.B., Jr., 2000, Methods for evaluation of transportation projects in the USA, *Transport Policy,* Volume 7 (1) 2000, pp.41-50

Morisugi, H, 2000, Evaluation methodologies of transportation projects in Japan, *Transport Policy,* Volume 7 (1) 2000, pp.3540

Nakamura, H. en T. Ueda, 1989, *The Impacts of the Shinkansen on Regional Development*, in: The Fifth World Conference on Transport Research, Yokohama, 1989, Vol. 111, Western Periodicals, Ventura, Califomia.

Nederlands Economisch Instituut (NEI), 1992, *Economische betekenis aansluiting Randstad op Europees Hogesnelheidsnet*, Rotterdam.

NEI, *2000, KBA van een snelle verbinding naar het noorden,* Rotterdam.

Nijkamp, P., B. Ubbels en M. Koetse, *2000, Infrastructuur als portfolio; een duurzaamheidsvisie op infrastructuur,* Delftse Universitaire Pers, Delft.

Nordqvist, S. en J. Rosen, 1984, Faster trains; Technology, Prospects and Impact, Stockholm.

Nyfer, 1999, Sporen van Vooruitgang, Breukelen.

Okabe, S., 1979, Impact of the Sanyo Shinkansen on Local Communities, in Straszak A. en Tuch, R. (eds.) The Shinkansen High-Speed Rail Network of Japan (Proceedings IIASA Conf. 1977), pp 11-20.

Plassard, F. (1989), Transport and Spatial Distribution of Activities, European Conference of Ministers of Transport, Round Table 85.

Quintet, E., 2000, Evaluation methodologies of transportation projects in France, *Transport Policy*, Volume 7 (1) 2000, pp.27-34

Rothengatter, W., 2000, Evaluation of infrastructure investments in Germany, *Transport Policy*, Volume 7 (1) 2000, pp.17-25

Sasaki, K., T. Ohashi en A. Ando, 1997, High-speed rail transit impact on regional systems: does the Shinkansen contribute to dispersion?, *Annals of Regional Science*, Volume 31 (1), pp. 77-98.

TNO Inro, Rijksuniversiteit Groningen, Vrije Universiteit Amsterdam, TU Dresden (2000), Indirecte Effecten Zuiderzeelijn hoofdrapport, Delft.

Vickermann, R., 2000, Evaluation methodologies for transport projects in the United Kingdom, *Transport Policy,* Volume 7 (1) 2000, pp.7-16